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Monticello PRA in Operations Training

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Outline

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Background information on Monticello Nuclear Generating Plant

- *GE BWR-3*
- *1775 MW_t 613 MW_e*
- *Commercial Operation: June 30,1971*
- *Plant Located 45 miles NW of Minneapolis, Minnesota*

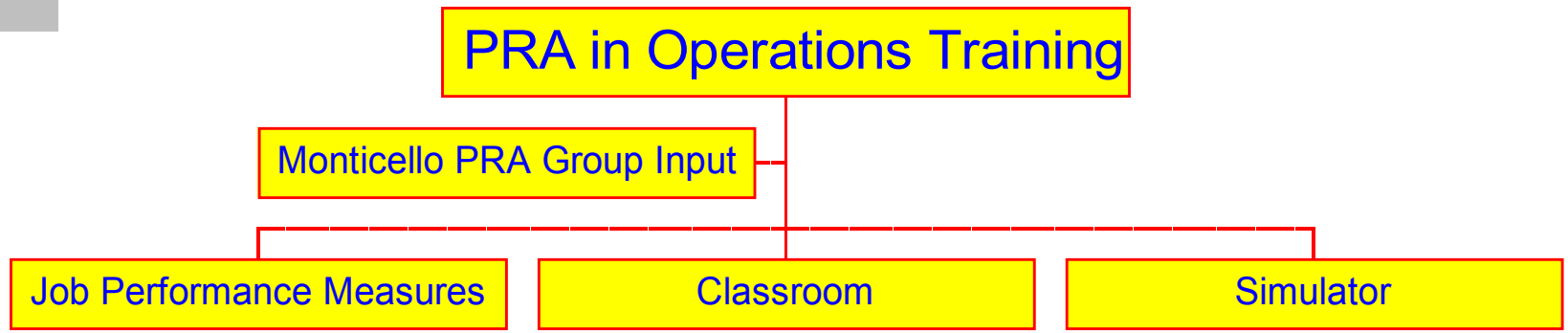
Background information on how Monticello has utilized PRA

- *Plant Modifications*
  - *Fire water crosstie to RPV*
  - *MSIV low level bypass switches*
  - *SRV/MSIV pneumatic system*
- *Proposed modifications*
  - *Gain in plant safety*
- *Justify continued operation*
- *Maintenance rule*
- *Quantify risk of taking equipment out of service (on-line and outage)*
- *Prioritization of maintenance activities*
- *Influence operating procedure changes (station blackout)*
- *MOV ranking*
- *Outage risk assessment*

PRA in Operations Training

- *Previous use of PRA has focused on physical plant changes and operational decision making*
- *In early 1997 a process was implemented in ops training that makes consistent use of the information available from the Monticello PRA to focus on improving human performance*
- *The intent of using PRA in operator training programs is to aid in maximizing plant safety*

PRA in Operator Training Programs



Classroom

- *Initial and continuing operator training programs*
  - *Familiarize operators with PRA*
    - *Fault and event trees*
    - *Key results*
  - *Introduce critical operator actions to avoid core damage that are most significant*
  - *System lesson plans expound on the critical actions specific to that system*

Classroom (continued)

- Prioritization of systems selected for continuing training
  - PRA system importance rankings by system
    - Based on a combination of two importance measures:
      - Risk Achievement Worth
      - Fussell Vesely
  - An algorithm is maintained that uses these PRA importance weighting factors to influence the selection of topics

Job Performance Measures

- *Critical operator actions modeled in the PRA are made into JPM's*
  - *Attachment 1*
- *The JPM's are used for evaluation of operator proficiency in performing a task (e.g. Align 13 diesel to supply power to battery chargers)*

Simulator

- *Simulator scenarios for training and evaluation utilize key PRA information*
- *This ensures that the most probable events that lead to core damage are covered in both simulator training and crew proficiency evaluations*

Simulator

- *Scenarios utilize the following PRA input*
  - *Initiating Event*
  - *Accident Class*
  - *Critical operator actions*
  - *Appropriate Cutset to utilize the above*

Simulator

- *Initiating event examples*
  - *Large/Medium/Small LOCA*
  - *Loss of condenser vacuum*
  - *Loss of offsite power*
  - *Loss of feedwater*
  - *Stuck open relief valve*
  - *Turbine trip*
  - *MSIV closure*
  - *Loss of a 125 VDC bus*
  - *Loss of instrument air*

Simulator

- *Accident class examples*
  - *Class 1A Loss of inventory makeup in which RPV pressure remains high*
  - *Class 1B Loss of AC power and Loss of Coolant inventory makeup*
  - *Class IC Failure to scram with loss of all inventory makeup*
  - *Class ID Loss of Coolant inventory makeup in which RPV pressure has been reduced*
  - *Class 2 Loss of containment heat removal*
  - *Class 3A-D LOCA events*
  - *Class 4 ATWS and failure to inject boron*
  - *Class 5 Unisolated LOCA outside containment*
  - *Class 6 Internal Flooding*

Simulator

- *Critical Operator Actions*
  - *Critical actions as modeled in the PRA that are challenged during the scenario (e.g. operator must depressurize the RPV manually)*
  - *Critical actions modeled in the PRA that are designed into the scenario as a result of equipment failures (e.g. Failure to initiate SBLC due to power supply problems)*

Simulator

- *Cutsets*
  - *Accident sequence failure combination*
  - *40,000 cutsets in the Monticello PRA*
  - *The individual CDFs for all cutsets are added together to obtain the total CDF estimate*
  - *The top 178 cutsets were selected*
  - *This resulted in 83% of the total CDF*

Simulator

- *Cutset example*
  - *Loss of feedwater (initiating event)*
  - *High Pressure Coolant Injection (HPCI) fails*
  - *Reactor Core Isolation Cooling (RCIC) fails*
  - *Failure to depressurize the RPV (critical operator action/human error)*

Simulator

- *By concentrating on the 178 selected cutsets the scenario creator has a manageable number to use with the highest probability of occurring*
- *The scenario creator has the PRA information available to get down to the component failure that resulted in the system failure*

Simulator

- *When appropriate during simulator training, the instructor will discuss the PRA inputs to the scenario*
- *This gives operators a perspective on what sequence of events, human errors, and equipment problems can lead to a core damaging event and what can be done to prevent getting to that point*

PRA vertical slice

- *Monticello submitted IPE report in 1992 to the NRC*
- *One of the insights from this report led to a modification to allow the plant fire system to be aligned to the RPV*
  - *This lowered the Monticello CDF*
- *This ability to crosstie fire water to the RPV is modeled in the Monticello PRA as a critical operator action*

PRA vertical slice continued

- *A job performance measure (JPM) was created to evaluate the ability of operators to perform this alignment*
- *This critical operator action is used in simulator scenarios*
- *Classroom training has this critical action built into the applicable system lesson plans*

Other uses in Ops Training

- *Prior to an outage a representative from the PRA group presents the risk timeline to all operators*
  - *This shows the critical points in an outage from a risk perspective*